

Hemagglutination Activity of the Fresh Edible Part of Vegetables and Fruits

C_{HEH}-M_{IN} S_U and Y_{IH}-C_{HIIH} T_{UNG}

ABSTRACT

The fresh or uncooked edible part (50 gm) of 16 kinds of vegetables and 24 kinds of fruits was extracted with normal saline (50 ml), and the hemagglutination activity of the extract against rat erythrocyte was determined. The results indicated that all of the extracts of the vegetables and the fruits could agglutinate rat erythrocyte. The vegetables and the fruits tested in this survey were (in the order of decreasing hemagglutination activity): water chesnut, lotus lily, Chinese cabbage, ginger, garlic, chilli, lemon, passion-fruit, kiwi fruit, banana, papaya, small tomato, grape fruit, kumquats, grape, apple, pineapple, lettuce, sweet orange, ponkan, wax jumbo, onion, purple cabbage, kohlrabi, egg-fruit, western melon, Indian jujube, strawberry, plum, tankan, bitter guard, water melon, loquat, carrot, celery, guava, carambola, small cucumber, green turnip and white turnip.

Key words: Hemagglutination, Lectin, Vegetable, Fruit, Fresh edible.

AAG (abrus agglutinin) is a lectin purified from the seeds of *Abrus precatorius*. This lectin can inhibit the growth of S-180 sarcoma cells in the experimental animals.⁽¹⁾ Recently, Tung and his associates found that orally administered AAG also had inhibitory effect on the pulmonary metastasis of S-180 sarcoma cells and B-16 melanoma cells in mice.⁽²⁾ They also demonstrated that oral administration of AAG and concanavalin A could increase the number of leucocytes in the peripheral blood and change the ratio of helper T lymphocyte and suppressor

T lymphocyte.⁽³⁾ The results of these experiments suggest that at least part of the lectins administered orally can pass through the intestinal wall as a whole protein molecule. The facts that wheat germ agglutinin and concanavalin A could escape intestinal digestion after oral administration had been reported.^(4,5) The research works mentioned above had attract our attention to and interest in the lectins of human diet, especially fresh edible vegetables and fruits.

MATERIALS AND METHODS

Preparation of vegetable and fruit extracts: 50 gm of the fresh edible part of a vegetable or fruit was extracted with 50 ml normal saline in a mixer and filtered through a whatman no. 1 paper. The filtrate was collected as original extract. The original extract was diluted with normal saline to make a series of two-fold diluted extracts.

Determination of hemagglutination activity: 0.5 ml of original or diluted extract was mixed in a test tube (1 x 10 cm) with 0.5 ml 1% rat erythrocyte suspension in normal saline. After standing at room temperature for 5 hours, hemagglutination was judged from the settling pattern of erythrocytes. Hemagglutination activity was expressed as the fold of dilution of the

most diluted extract which could induce hemagglutination.

The vegetables and the fruits were bought from the supermarkets in Taipei city.

RESULTS AND DISCUSSION

In this survey we had tested 16 kinds of vegetables and 24 kinds of fruits. We emphasize the vegetables should be fresh edible because the lectins are proteins and very sensitive to heat treatment. For example, tomato lectin is destroyed completely after boiling for 15 minutes and about 95% wheat germ agglutinin activity is lost after heat processing.^(4,6)

Hemagglutination activity of the extracts of the vegetables and the fruits are shown in Table 1 and Table 2. The results indicate that all of the extracts tested have agglutination activity

Table 1. Hemagglutination activity of the fresh edible part of vegetables.

English	Name	Chinese	Hemagglutination activity
Water chesnut		荸薺	512
Lotus lily		蓮藕	512
Chinese cabbage		結球白菜	512
Ginger		薑	512
Chilli		辣椒	512
Garlic		大蒜	512
Lettuce		結球萵苣	64
Onion		洋葱	32
Purple cabbage		紫高麗	32
Kohlrabi		球莖甘藍	32
Bitter guard		苦瓜	16
Carrot		胡蘿蔔	8
Celery		芹菜	8
Small cucumber		小胡瓜	4
Green turnip		青蘿蔔	4
White turnip		白蘿蔔	1

Table 2. Hemagglutination activity of the fresh edible part of fruits.

English	Name	Chinese	Hemagglutination activity
Lemon		檸檬	512
Passion-fruit		百香果	512
Banana		香蕉	256
Papaya		木瓜	256
Grape fruit		葡萄柚	256
Small tomato		小蕃茄	256
Kiwi fruit		獼猴桃	256
Kumquats		金柑	256
Grape		葡萄	128
Apple		蘋果	128
Pineapple		鳳梨	128
Sweet orange		柳橙	64
Ponkan		椪柑	64
Wax jumbo		蓮霧	64
Egg-fruit		蛋黃果	32
Western melon		洋香瓜	32
Indian jujube		印度棗	32
Strawberry		草莓	32
Plum		李子	32
Tankan		桶柑	32
Water melon		西瓜	16
Loquat		枇杷	16
Guava		番石榴	8
Carambola		楊桃	8

toward rat erythrocytes. It can be considered that lectins are ubiquitous in vegetables and fruits. It should be mentioned that some of the vegetables such as Chinese cabbage are not really fresh edible, but these vegetables are the main materials for making the macerated foods which can be eat uncooked.

Our results indicate only the vegetables and the fruits contain lectins but not their lectin contents. Since hemagglutination activity of the extract depends on the method of extraction. We had extracted carrot with 5% acetic acid solution, and the crude extract obtained after

dialysis and lyophilization could agglutinate rat erythrocytes at the concentration of 1 $\mu\text{g}/\text{ml}$. However, the crude extract of banana obtained by the same procedure had no activity at the concentration of 1 mg/ml .

Further studies on the vegetable lectins and the fruit lectins are necessary to evaluate the medicinal or nutritional value of these lectins.

REFERENCES

1. TUNG TC, YANG TT, CHANG HC: The

- growth inhibition of S-180 sarcoma cells by abrus agglutinin treatment in vivo. J Formosan Med Assoc 80; 1-6, 1981.
2. TUNG TC, WANG YF, HWANG HF et al: Inhibitory effect of orally administered abrus agglutinin on the metasis of sarcoma-180 and B-16 melanoma. J Chinese Oncol Soc 3; 1-8, 1987.
 3. TUNG TC, WANG YF, HWANG HF: Absorption of orally administered lectins. J Chinese Oncol Soc 3; 9-15, 1987.
 4. BRADY PG, VANNIER AM, BANWELL JG: Identification of the dietary lectin, wheat germ agglutinin, in human intestinal contents. Gastroenterology 75; 236-239, 1978.
 5. FREED DLJ, BUCKLEY CH: Mucottractive effect of lectin. Lancet 585-586, 1978.
 6. NACHBAR MS, OPPENHEIM JD, THOMAS JO: Lectins in the U.S. diet. Isolation and characterization of a lectin from the tomato (*Lycopersicon esculentum*). J Biol Chem 255; 2056-2061, 1980.

蔬菜水果可生食部份的紅血球凝集活性

蘇哲民 董一致

取蔬菜或水果可生食部分 50 公克，置果汁機中以 50 毫升生理食鹽水萃取，過濾後取濾液並測定其對大白鼠之紅血球的凝集活性。本調查工作共做了 16 種蔬菜和 24 種水果，結果顯示各種蔬菜和水果的萃取液，都具有紅血球凝集活性。本實驗所做的蔬菜和水果是(按凝集活性高低順序)：結球白菜、薑、大蒜、辣椒、蓮藕、荸薺、檸檬、百香果、獼猴桃、香蕉、木瓜、小蕃茄、葡萄柚、金柑、葡萄、蘋果、鳳梨、結球萵苣、柳橙、椪柑、蓮霧、洋葱、紫高麗、球莖甘藍、蛋黃果、洋香瓜、印度棗、草莓、李子、桶柑、苦瓜、西瓜、枇杷、胡蘿蔔、芹菜、番石榴、楊桃、小胡瓜、青蘿蔔和白蘿蔔。

台北醫學院 生化學科

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